C. GEOMETRY

C.1 Three- and Two-Dimensional Shapes

CLASSROOM ACTIVITIES[1]
(Preschool and Kindergarten)

Provide each youngster with a geoboard and several rubber bands and let creativity begin.

FAMILIAR SHAPES

On your geoboard, show how to make some shapes that look like something in this room. Try to make something that can be found in the kitchen, basement, yard, grocery store, playground, garage. Show something your dad uses. Show something that is alive.

Possible Questions

Can you tell your friend what you have made?
Look at something someone else has made and try to guess what it is.
Does your figure look the same if you turn the geoboard around?
How many sides does your figure have?
How many corners does your figure have?
Are there more corners or more sides?

PLANE FIGURES

Try to make figures with three sides that are small, large, "skinny," "fat." Try to make figures with four sides that are long, short, long and wide, long and narrow, short and narrow, "like a square," "not like a square."

Possible Questions

What does the figure you have made remind you of?
Does it look like anything that is familiar to you?
Where did you see something like it before?
Does the figure change if you turn your geoboard?

Make two figures that (1) do not touch, (2) touch, (3) cut into each other. Look at the figures you have made.

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[1]"Geoboard Geometry for Preschool Children," *The Arithmetic Teacher*, February 1970, pp.123-126.

SEGMENTS

Try to make segments that are short, long, straight, "crooked." Try to make segments that do not touch, touch, cross each other (intersect), will *never* touch (parallel), are exactly on top of each other. Try to make various segments leading to two (or more) points, various numbers of segments (for example, two that are equal), two that are not equal, many different segments.

Possible Questions

How would you make a road?
Can you make a very narrow road?
Can you make one that is long and narrow?
Make a railroad track.
Can you make a road and a train track that cross? Do not cross? Will never cross?

Look at two pegs in different corners. How many different roads (crooked or straight, few or many corners) can you build between these two pegs? Which road would you like to travel on? Why?

Three-Dimensional Shapes: Grades I, II, III *(Hamel)*

We need to question continually the values of certain forms of geometry for our students, especially at the primary grade level. Below are some statements to substantiate the inclusion of geometry at this level.

- Children can see position, slope, and size as something they can understand, use and manipulate to explore their environment.

- Children are able to use geometric insights to facilitate and develop creativity and the spirit of inquiry.

Geometry is indispensable in our way of life. From their very structure, form and beauty, all objects are governed by properties of geometry. This is what the children at the primary level should realize - first structure and secondly form.

The students are asked to collect objects from their environment. These objects (flowers, leaves, boxes) will help them in studying two-dimensional shapes. The students can be presented with a series of open-ended questions which will help them in the development of learning shapes

Developmental Questions (for discovering shapes - three dimensional)

1. Take all the small boxes and see how many different shapes you can make. How do your shapes compare? Are some smaller than others? [*When a child has spent time making different shapes, he begins to think about two-dimensional shapes for himself.*]

2. Take balls, cylinders and boxes and notice how different they are from each other. How different does a ball roll from a cylinder? [*When a child manipulates certain shapes, he will quickly realize and be able to think in a three-dimensional pattern.*]

3. Sort boxes as to height and see how many other ways you can sort them (color, width, etc.).

Distribute popsickle sticks and thumbtacks to the students and ask

4. How many different shapes can you make with the thumbtacks and popsickle sticks? Do some of them move? Which ones do not move?

Give the students certain objects and ask the students what other objects they can make from them (a square can be made from two triangles). Then give them some other objects (triangles, squares, cubes, rectangles) and ask them the same question.

Students must first learn how to work with two-dimensional shapes before being introduced to three-dimensional shapes. Let them manipulate objects and get a feel for them. Later they can be given three-dimensional work (as in developmental question 1) and explore different ways of using objects.

Geometry *(Risvold)*

WORKSHOP #1

Assignment 1

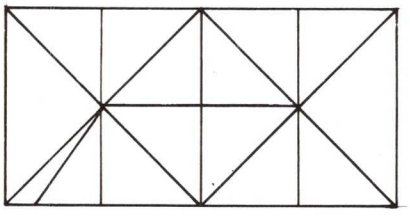
How many different shapes can you see in the classroom, outside and at home? Draw these shapes. Use all the shapes you have made and prepare a chart. It could look like this.

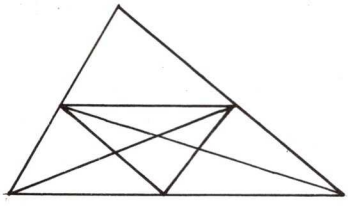
Shape	*Number - Vertices*	*Number - Sides*	*Number - Angles*
△	3	3	

Assignment 2

a) How could you design a one-room house of the future? Try to build your house.

b) How many triangles are there.





c) How would you name these triangles?
Make puzzles like these for your friends to solve.

Assignment 3

a) Using strips of paper and paper fasteners, make as many different figures as you can.

b) Using one or more of the shapes you have made (or the cardboard ones which are already made) make an interesting design.

Assignment 4

a) With two parallel lines, what are the most points of intersection using
- two intersecting lines?
- three intersecting lines?
- four intersecting lines?

How would you make a chart of this?

b) Draw some pairs and sets of parallel lines in your book - some straight, some curved.

c) Write down examples of some parallel lines you know.

[*These assignments should be discussed with the class to clarify any difficulties.*]

WORKSHOP #2
(Each pupil should have a typed copy)

Circles

a) Using the round objects provided (tins, bottles, colored discs), guess the diameter and circumference. How many guessed correctly? How could you show that on a graph?

b) Is any part of you round? Can you find objects the same circumference? How could you make a chart of this?

c) Circles can be used to make interesting designs. How could you make a design?

Perimeter and Area

a) How many different shapes can you cut from one-inch graph paper using one square, two squares, three squares, four squares, five squares? What is the perimeter and area of each shape? Is there a pattern?

b) Who in the class has the smallest footprint? How can you find the area and perimeter of the footprint?

c) Using the geoboard, make a shape. See if a friend can find the area.

Angles

a) Draw ten angles on a piece of paper. How can you find out if these angles are bigger or smaller than a right angle?

b) How many total degrees are there in the angles of a triangle? Does this change with different shapes and sizes of triangles? Can you find out how many degrees there are in other polygons?

c) Make a circle and divide it into five parts. Name the angles you made and find the total number of degrees in the whole circle. How many degrees are in bigger circles, smaller circles?

Squares and Rectangles

a) On a sheet of graph paper, cut out squares with sides of one inch, two inches, three inches, and four inches. In how many ways can you measure these squares? How could you show this?

b) You are planning to keep chickens in your garden. You have 20 feet of wire fence and you wish to make the pen as large in area as you can. What would be the length and width which will enclose the largest area?

c) Using strips of paper and paper fasteners, make some rectangles. By pushing the sides, change your rectangles into parallelograms. Is the area the same?

General Introduction to Shape: Grade III *(Foran)*

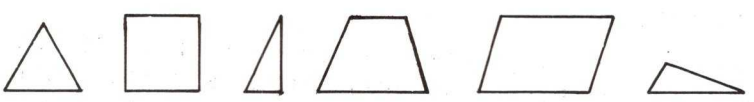
OBJECTIVES To introduce various shapes and how to make them; to name the various shapes and show how they can be put together to form other similar or different shapes; to observe and compare the differences between shapes; to gain background for work on perimeter and area.

MATERIALS Geoboards, plastics of various colors, cut-out shapes, 1" squares of paper, paper and other equipment (for recording results).

1. How many different shapes can you make using your geoboard? How many of these can you name? Show us your shapes in diagram.

2. How many shapes can you make using 2, 3, 4, 5, pegs on your geoboard? Can you see any similarities in any of the shapes?

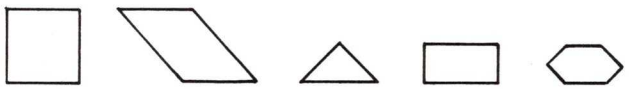
3. Given these shapes:



[*These shapes should be cut of different colors of construction paper and given to the students.*]

How many ways can you group them? Show us your results.

4. Using one of these shapes as often as you wish, what other shapes can you make?



[*Sets of these should be cut of construction paper and given to the students. They will need more paper to make more of the shapes they choose.*]

What other shapes can you see inside the shapes you made?

5. Cut out a square piece of paper. How many shapes can you find by folding it in various ways?

6. How many shapes can you make from 2 units; 3, 4, 5, units? Compare the shapes you make. One unit = 1" square of paper.

7. How many objects in the room are similar in shape? See how many different groups you can form.

8. Stretch an elastic band into a circle shape on your geoboard. Use other bands to make regular polygons inside the circle. Increase the number of sides. How many sides can you get in a figure? How many sides does a circle have?

FOLLOW-UP GAMES AND ACTIVITIES

- Curve stitching to see different types of curves.
- Working with tangrams to see how shapes can be combined.

FUTURE WORKSHOPS:

- Work on perimeters.
- Work on area.
- Work on symmetry.
- Work on tessellations.

[*Many of these ideas, started in workshops, can be expanded later.*]

Symmetry in Shapes: Grade IV *(Hamilton)*

1. Look around you. Make a list of as many shapes as you can see in the classroom. Do any of these shapes appear to be similar? Try grouping all the similar shapes together. Your heading might be, "Shapes I See That Are Similar To The Floor Tiles," or "Shapes I See That Are Similar To The Windows," etc.

2. Here are some pieces of manilla paper and also some pieces of carbon paper. Fold each piece of manilla paper in half and place one side down on the carbon paper. Write your name in large letters on the side facing you, making sure that each letter comes all the way down to the fold in the paper. Press very hard with your pencil. Now look carefully at what you have done. Do both sides appear to be the same? Now, with your crayons, try making shapes on each side to form an interesting pattern so that both sides will look the same. Examine all the shapes you have made. Write a few sentences about them. Does your drawing remind you of something you've seen before?

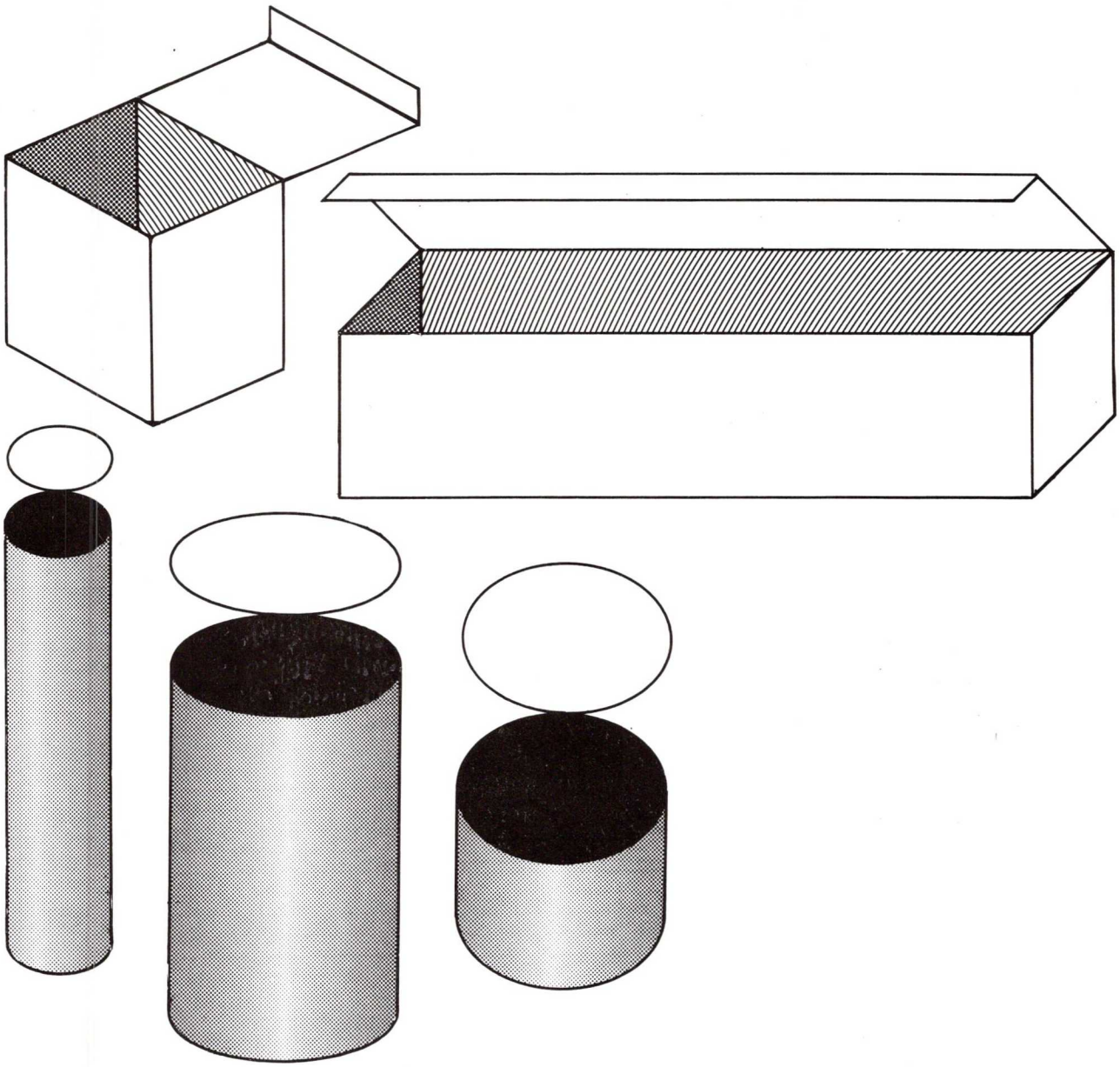
3. Here are some scissors and pieces of colored tissue paper. Try folding your piece of paper once, and cut out shapes with your scissors to make an interesting pattern. Try and get something completely different from the others in your group and be careful not to cut away all of the fold or you will have *two* pieces of paper instead of one. When everyone is finished, look carefully at the designs that were made on each side of the fold. Discuss them together. How many different shapes do you see? Are any of these shapes similar to other shapes you are familiar with? Note carefully what you see on each side of the fold. Write one or two sentences about what you see. Now, do the same as you just did only this time try folding the paper twice, then three times, then four times. Can anybody fold five times for some really interesting patterns?

4. Think about nature for a moment. Does nature provide for us any shapes that show symmetry? Go out to the playground. How many different things in nature can you find that are good examples of symmetry? Collect some and bring them back to the work table. Try reproducing some of these shapes on paper. What do you notice about each shape? Can you write a sentence or two to describe what you see? Do any of these shapes remind you of some of the more regular shapes on the list you made of classroom shapes? (Here the children will probably say some of the flowers look like circles, some leaves like triangles, etc.)

5. The idea similar to that brought out in item 3 could also be done using ink blots, or, better still, for a more colorful effect, using drops of different colored paints. Again, the children could discuss their patterns and write a few sentences about each. You would probably not have each group do *both* questions unless you have extra time.

6. Collect an assortment of different shaped boxes (shoe boxes, rectangular, square, round boxes; hexagonal boxes that felt-tipped pens come in would be excellent for this). Make sure that each box has a lid. How many different ways can the lids be replaced on these boxes? Record them. What does this tell you about the symmetries of the boxes and the lids? Are any boxes more symmetrical than others?

7. Symmetry by reflection - here is an assortment of rectangular and square shapes. Trace around the edges of some of them on a sheet of paper. Cut out these paper shapes. How many ways can you fold these shapes so that one half matches the other half? Each fold is called an axis of "symmetry." How many axes of symmetry does each figure have?



8. Try writing down all the capital letters that appear balanced about an "up and down" axis of symmetry. (A is one example.) Show the axis by a dotted line on each letter. Do the same with all the letters which appear balanced about an "across the page" axis of symmetry. (K is one example.) Show the axis by a dotted line on each letter.

A K N

9. Some letters look the same if you turn them through half a complete turn about a point marked. Here is one example: N. (Dot shows the point marked.) Find all the other letters that look the same when turned in this way. Now make lists showing everything that you discovered. Would any letters be included in two lists? Make an interesting display showing your findings.

10. You can find examples of symmetry in human faces, pictures, advertisements, etc. Find as many examples as you can and make an interesting display with them.

[*A very interesting art lesson and one which children really enjoy is to collect many pictures of human faces and cut them in half. Then have the children choose one, mount it on a piece of paper and try to draw the other half of the face. A good art lesson on symmetry!*]

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